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**DRIVERS' GENERAL INSTRUCTIONS FOR
THE OPERATION OF DIESEL TRAIN
LOCOMOTIVES, DIESEL SHUNTING
LOCOMOTIVES AND DIESEL MULTIPLE
UNIT TRAINS WITH ELECTRIC,
HYDRAULIC AND MECHANICAL
TRANSMISSIONS**

DRIVERS' INSTRUCTIONS FOR THE OPERATION OF DIESEL TRAIN LOCOMOTIVES, DIESEL SHUNTING LOCOMOTIVES AND DIESEL MULTIPLE UNIT TRAINS WITH ELECTRICAL, HYDRAULIC AND MECHANICAL TRANSMISSIONS

GENERAL INFORMATION

SCOPE OF BOOK

The information contained in this book supersedes that given in all existing Driving Instructions in respect of the following:-

General information and miscellaneous instructions

Driver's Safety Device

Fire

Derailments

Hauling

Coupling of locomotives

Multiple and tandem working

Standard preparation and disposal duties for multiple locomotives

Assisting

Attaching and detaching

Engine running in stations

Booklet B.R.33062 is also superseded in respect of Diesel traction.

As existing Driving Instructions for individual types of traction equipment are revised, the general information will be eliminated from them. In addition the books will be issued in separate parts as follows:-

Part 1. General data and equipment (Salmon Pink cover).

Part 2. Driving Instructions including Standard Preparation and Disposal Duties (Blue cover).

Part 3. Fault finding data and charts (Green cover).

A separate booklet will be issued for Clayton, Spanner and Stone Vapor boilers. This will have an Orange cover.

Instructions for Diesel shunting locomotives, incorporating the three parts described above, will be issued as one booklet for each type with Yellow covers.

GLOSSARY OF TERMS

The purpose of the various instructions will be more readily appreciated if an attempt is made to understand the functions of the principal parts of Diesel locomotives and trains. The functions of the majority of components are described in "DIESEL TRACTION Manual for Enginemen" 1962 and various other data which is issued, but a brief description of the purpose of some principal parts is given here.

Initials follow the name of each component to indicate the type of unit in which it may be found. These are as follows:-

D.T.L.—Diesel train locomotive

D.S.—Diesel shunting locomotive

D.M.U.—Diesel multiple unit

D.E.M.U.—Diesel electric multiple unit.

DIESEL ENGINE—D.T.L., D.S., D.M.U., D.E.M.U.

A device for converting the chemical energy in the fuel into mechanical power. Diesel engines used for rail traction purposes in this country work on the four-stroke cycle principle, with the exception of Napier "Deltic" types. The majority of Diesel engines employ a single crankshaft and may have their cylinders:-

(a) "in line" in vertical formation.

(b) "in line" in horizontal or near horizontal formation.

(c) "Vee" formation in which the angle between the banks of cylinders varies between 45° and 60° .

The majority of Sulzer twelve cylinder engines have two crankshafts, each of which is driven by a separate bank of six cylinders. The outputs of the two crankshafts are geared together by an interposing pinion which transfers the combined output to the main generator.

Deltic engines consist of three banks of cylinders with opposed pistons, the centre lines of which are arranged to form an equilateral triangle.

MAIN GENERATOR—D.T.L., D.S., D.E.M.U.

A device for converting the mechanical energy, produced by the Diesel engine into electrical energy. This power is then fed along cables to the motor contactors in the control cubicle and from there to the traction motors which may be connected in parallel or series parallel. By using electric transmissions, the Diesel engine power can be applied to the wheels through flexible cables and without the necessity for complex shafts etc.

Main generators of Diesel train locomotives contain a separately excited field system, the strength of which is adjusted by the torque regulator. A self excited field system is also used in many instances. A starting field system is incorporated in all main generators which enables them to be used for engine starting purposes.

TRACTION MOTOR—D.T.L., D.S., D.E.M.U.

A device for converting the electrical output from the main generator into mechanical power for the purpose of driving the road wheels. Traction motors have a series field system and can, therefore, exert the very high torque which may be necessary to move a train from a state of rest. The field system of traction motors can be weakened in stages by diverting some of the current through shunt resistances. The weakening of the field strength of the motors reduces their ability to produce a back E.M.F. (electromotive force) which would, in effect, oppose the flow of current from the main generator as the train speed increases. Field weakening can be introduced in as many as six stages before a locomotive reaches its maximum speed.

All electric transmission control systems incorporate a switching arrangement for reversing the current direction through the field systems of the traction motors in order to reverse their direction, without the use of gearing devices.

All traction motors are connected to the axles by gearing which may be of a single reduction type, with a ratio of between 3 to 1 and 4 to 1 (D.T.L., D.E.M.U.), or double reduction type with a ratio of between 19 to 1 and 24 to 1 (D.S.). The traction motors of Diesel shunting locomotives can be switched from parallel to series connections by the Driver when a very high tractive effort is required for moving very large loads e.g. when hump shunting.

TORQUE CONVERTOR—D.T.L., D.S., D.M.U.

A component for transmitting the Diesel engine power to the axles and multiplying the engine torque at low road speeds to provide a high starting tractive effort. The engine drives a centrifugal pump which accelerates a suitable fluid to a high velocity. This fluid is then used to drive a turbine. The turbine may be arranged to drive a final drive gearbox directly, or alternatively, its output shaft may drive through various other constant ratio or speed change gearing devices.

A hydraulic transmission may be an assembly consisting of several different torque convertors, each of which operates within a certain road speed range only, or there may be fluid couplings or plate clutches which supersede the function of the torque convertor arrangements after certain road speeds have been obtained. Reversing arrangements may be attached to the torque convertor assembly or alternatively be incorporated within the final drive gearbox.

SPEED CHANGE GEARBOX—D.S., D.M.U.

A component in a mechanical transmission which enables the Driver to select any one of four or five gear ratios in order to obtain the best matching between the Diesel engine and the driving axle at any road speed.

FLUID FLYWHEEL OR FLUID COUPLING—D.S., D.M.U.

A component in a mechanical transmission, situated between the Diesel engine and the speed change gearbox or freewheel shaft, which will transmit power when the input shaft is turned at high speed, but which will transmit little or no power when the input speed is low. Fluid couplings are used in place of plate clutches when epicyclic speed change gearboxes are used. They may also be used as constituent components within a hydraulic transmission for maintaining the drive after initial acceleration by a torque convertor.

FREEWHEEL SHAFT—D.M.U.

A part of a mechanical or hydraulic transmission which enables a train to coast at a higher speed than that which it would run if directly driven by the engine through the fluid coupling or torque convertor output.

FINAL DRIVE GEARBOX—D.T.L., D.S., D.M.U.

A component of a mechanical or hydraulic transmission which enables the power of the Diesel engine to be applied to the driving axle(s). Some final drive gearboxes, including all of those in use on D.M.U. trains incorporate a reversing mechanism.

CARDAN SHAFT—D.T.L., D.M.U.

A component in a mechanical or hydraulic transmission which connects a driving component to a driven component which is not fixed in a constant relative position.

RADIATOR—D.T.L., D.S., D.M.U., D.E.M.U.

A large group of tubes through which the engine lubricating oil and/or coolant is pumped for cooling purposes. The coolant temperature is normally maintained between 155°F and 190°F. A bye-pass valve is provided in cooling systems to regulate the coolant flow through the radiator(s) in order to maintain the temperature approximately constant, irrespective of the load on the Diesel engine. Additionally, some radiators are equipped with shutters in order to regulate the flow of air and also to retain the heat during periods when the engine is not being used.

RADIATOR FAN—D.T.L., D.S., D.M.U., D.E.M.U.

Radiator fans are provided to draw air from the atmosphere through the radiator elements. They may be driven mechanically from the free end of the Diesel engine, hydrostatically, or electrically. The two latter methods incorporate means by which the fan speed may be varied according to the temperature of the coolant.

AUXILIARY GENERATOR—D.T.L., D.S., D.E.M.U.

An engine driven generator which supplies current at a constant voltage for the purpose of driving the auxiliary machines, battery charging and energising the control circuits.

DYNASTARTER—D.T.L.

The dynastarter of a Diesel hydraulic locomotive performs a similar function to an auxiliary generator but also performs the additional function of starting the Diesel engine.

ALTERNATOR—D.M.U.

An engine driven device for producing alternating current, which is rectified to direct current, for the purpose of charging the battery and energising the control circuits.

STARTER MOTOR—D.S., D.M.U.

A battery driven motor for the purpose of starting a Diesel engine in a Diesel mechanical or Diesel hydraulic system.

COMPRESSOR—D.T.L., D.S., D.M.U., D.E.M.U.

A device for raising air pressure in a main reservoir to approximately 100 p.s.i. or in some dual braked locomotives to approximately 140 p.s.i. This pressure is then reduced as necessary for the following purposes:-

- (a) The air brakes, either "straight air" or "automatic" (D.T.L., D.E.M.U., D.S.).
- (b) Electro-pneumatic control equipment (D.T.L., D.E.M.U., D.M.U.).
- (c) Sanding gear (D.T.L., D.S., D.E.M.U.).
- (d) Windscreen wipers (D.T.L., D.S., D.E.M.U., D.M.U.).
- (e) Warning horns (D.T.L., D.S., D.E.M.U., D.M.U.).
- (f) Throttle motors (D.M.U.).

(g) Speed change gearboxes (D.M.U., D.S.).

(h) Reversing mechanisms (D.T.L., D.E.M.U., D.M.U., D.S.).

(i) Driver's Safety Device (D.T.L., D.S., D.E.M.U.).

TRACTION MOTOR BLOWER—D.T.L., D.S.

A device for forcing cooling air through the traction motors.

FUEL TRANSFER PUMP—D.T.L., D.S., D.E.M.U.

A device for drawing fuel from the main tanks and forcing it through filters to the Diesel engine.

LUBRICATING OIL PRIMING PUMP—D.T.L., D.S., D.E.M.U.

A device for priming the engine governor with lubricating oil. This process enables the engine to receive fuel when being turned by the battery for starting purposes and thereby ensures easier starting.

LUBRICATING OIL PUMP—D.T.L., D.S., D.M.U., D.E.M.U.

An engine driven pump, usually in two sections, which draws lubricating oil through a strainer, from the engine sump and then forces it through filters to the engine bearings, governor etc.

COOLANT PUMP—D.T.L., D.S., D.M.U., D.E.M.U.

A centrifugal pump which may be either driven by the Diesel engine, or by a motor, for the purpose of circulating coolant through the cooling system.

TRIPLE PUMP—D.T.L. (SULZER ENGINES)

A combined pump set consisting of a lubricating oil priming pump, coolant pump and fuel transfer pump driven by a single motor.

BATTERY—D.T.L., D.S., D.M.U., D.E.M.U.

An assembly of either lead/acid or alkaline cells which is primarily intended for providing current to start the Diesel engine. The battery can also be arranged to provide power for certain auxiliary machines which are required to run before the Diesel engine is started, to energise control circuits and to provide a lighting supply. The battery is under a constant charge in Diesel train locomotives and Diesel electric multiple units, but may only charge under certain conditions in shunting locomotives and Diesel multiple units. (See the appropriate driving instructions).

VOLTAGE REGULATOR—D.T.L., D.S., D.E.M.U.

A device for regulating the output voltage of the auxiliary generator to a constant level, irrespective of the Diesel engine speed and current loading.

GOVERNOR—D.T.L., D.S., D.M.U., D.E.M.U.

A device which will maintain the Diesel engine crankshaft speed at an approximately constant value against varying loadings imposed by the transmission. A governor will also ensure that a predetermined idling speed is always maintained and a predetermined maximum speed is not exceeded. The governors of some engines fitted to D.M.U. cars only control the idling and maximum speeds and allow the Driver to control the intermediate speeds.

ENGINE OVERSPEED GOVERNOR—D.T.L., D.E.M.U.

A device which will stop a Diesel engine if the crankshaft speed exceeds the maximum governed speed. An engine cannot be restarted after the overspeed device has tripped until it has been re-set.

TURBO CHARGER—D.T.L., D.E.M.U.

An exhaust gas driven device for forcing more air into the cylinders of a Diesel engine than the pistons would induce by normal aspiration. The extra weight of air forced into each cylinder enables a greater weight of fuel to be burned during each working stroke and greater engine power can, therefore, be obtained for a given crankshaft speed.

INTERCOOLER—D.T.L.

A device for cooling the air delivered by the turbo charger. The cooling of the air increases its density and by doing this a greater weight can be forced into the cylinders than by supercharging alone. This enables more power to be obtained at a given crankshaft speed.

FUEL INJECTION PUMP—D.T.L., D.S., D.M.U., D.E.M.U.

A device for supplying a precisely measured quantity of fuel at high pressure to a fuel injector. The quantity of fuel delivered by each fuel pump to each working stroke of its associated cylinder is controlled by the engine governor which is, in turn, under the control of the Driver.

FUEL INJECTOR—D.T.L., D.S., D.E.M.U.

A device for spraying fuel delivered from the fuel pump, at high pressure, into a Diesel engine cylinder. The air in the cylinder, which has become heated by the rapid compression, ignites the fuel spray spontaneously.

CONTACTOR—D.T.L., D.S., D.E.M.U.

A device for opening or closing a circuit which carries a heavy current. Small contactors are operated electromagnetically (E.M. type) whereas larger ones are usually designed to operate electro-pneumatically (E.P. type) if an air supply is always available at the required time of operation, i.e. after the compressor has been started.

RELAY—D.T.L., D.S., D.M.U., D.E.M.U.

A device for opening or closing one or more circuits according to the current or voltage conditions in one or more separate circuits.

ELECTRO-PNEUMATIC VALVE—D.T.L., D.S., D.M.U., D.E.M.U.

An electrically operated valve for controlling the supply of compressed air to operate electro-pneumatic contactors, speed change gearboxes, reversing gearboxes, etc.

LOAD REGULATOR—D.T.L., D.E.M.U.

A rheostat or variable resistance, operated by the Diesel engine governor, to control the field current of the main generator in such a way that its output to the traction motors will always be regulated to take full advantage of the power available at any setting of the power handle. Load regulators usually incorporate a switching device near to the minimum resistance, i.e. maximum generator field strength position, for the purpose of introducing traction motor field diversion.

DRIVER'S SAFETY DEVICE—D.T.L., D.S., D.M.U., D.E.M.U.

A device for cutting off the engine power and applying the brakes in the event of a Driver becoming incapacitated when driving. The device may be operated by depressing the power handle (D.M.U., D.E.M.U.) or by depressing a treadle (D.T.L., D.S., D.E.M.U. Pullman trains). Certain D.M.U. trains require the power handle to be held in the required power position. A "hold over" button is provided (D.T.L., D.M.U.) on the right hand side of the driving compartment to enable the Driver to cross to the opposite side without the brakes being applied. In the event of the Driver's Safety Device being released, a full brake application will commence after a delay of 5-7 seconds, with the exception of D.E.M.U. trains operating on the Southern Region, in which the application is instantaneous.

The Driver's Safety Device of some locomotives incorporates a vigilance system. The pedal, when used with a vigilance system, has three positions which are as follows:-

- (1) "Released" position i.e. with no pressure applied.
- (2) "Balanced" or "Mid" position.
- (3) "Reset" position.

A timing device in a vigilance system operates an audible warning after the pedal has been maintained in the "Mid" position for a certain period; usually in the order of one minute. The pedal must then be depressed to the "Reset" position and returned to the "Mid" position. Failure to do this will result in a brake application, 5 to 7 seconds after the sounding of the warning. Pressing the A.W.S. reset button when the horn is sounding will also reset the vigilance device.

The Driver's Safety Device is inoperative in the E.O. and OFF positions (D.T.L., D.E.M.U.) and NEUTRAL position (D.T.L., D.S.)

MISCELLANEOUS INSTRUCTIONS

DRIVER'S SAFETY DEVICE

When a diesel locomotive or diesel multiple unit, other than a disabled one, is in motion, the Driver's Safety Device must not be made inoperative by any means whatsoever and the reversing handle must be retained in the position indicating the direction of travel.

Should the driver's safety device fail in traffic, it must be isolated and the appropriate instructions observed.

The isolation of one D.S.D. unit on a D.M.U. train even though this may be in the leading driving compartment, does not render any other D.S.D. unit on the train inoperative. A second man is only required if all D.S.D. units on a D.M.U. train are inoperative.

FIRE RISK

Open flame lamps must not be used in or near Diesel locomotives or trains.

No cloths, waste paper or litter of any description must be left in any engine rooms or on any underfloor equipment and any such refuse which is seen must be removed.

All instances of fuel leakage must be reported at the first opportunity. If fuel leakage occurs during a journey and cannot be corrected, the unit must be failed if a serious fire risk is incurred

If fuel leakage occurs in the vicinity of exhaust pipes on D.M.U. cars the appropriate engine(s) should be isolated.

Defective exhaust joints or holes in exhaust systems, silencers etc. can be detected audibly on D.M.U. cars, especially when the associated engine is speeded up.

If exhaust system defects allow hot exhaust to blow directly on to inflammable deposits on any underframe equipment the associated engine must be isolated.

FIRE EXTINGUISHERS

Fire extinguishing systems may be broadly classified as follows:-

- (1) 2½ lb., CO₂ gas, hand extinguishers.
- (2) Gas expelled, water filled, portable extinguishers.
- (3) 12 lb. B.C.F. hand extinguishers.
- (4) Graviner automatic extinguishers for extinguishing fires on underfloor engines of D.M.U. cars.
- (5) CO₂ gas, fixed installations, used in Diesel train locomotives and D.E.M.U. power cars. These operate automatically in D.E.M.U. power cars and in some locomotives. In other locomotives they are operated manually if it is decided by the driver that a fire cannot be extinguished by hand extinguishers.

ON ELECTRIFIED LINES WATER OR EXTINGUISHERS CONTAINING WATER MUST NOT BE USED UNDER ANY CIRCUMSTANCES UNTIL THE ELECTRICITY HAS BEEN SWITCHED OFF FROM THE VICINITY OF THE FIRE.

All fixed installations are equipped with detector systems which will ring a bell in each driving compartment and also in the Guard's compartment of D.M.U. trains. A bell test button is provided in each driving compartment or engine room of locomotives and D.E.M.U. cars and on the fire equipment control box of D.M.U. cars. The fire alarm bells should be tested on every vehicle during preparation or when taking over.

In automatic systems an outbreak of fire within the locomotive causes the bells to ring, the Diesel engine to stop and then a release of CO₂ gas. A Diesel locomotive must be failed after the discharge of its fixed fire extinguishing equipment, whether this be of the automatic type or not.

Locomotives with manually operated fixed fire extinguishing equipment will sound the alarm bells in the event of an internal fire.

If the fire alarm bells ring:-

- (1) Bring the train to a stand.
- (2) Stop the engine(s).
- (3) Stop the boiler (where applicable).
- (4) Move the reversing handle to the OFF position.
- (5) Obtain a hand extinguisher and locate the source of the fire.
- (6) If the fire can be extinguished by hand extinguishers, apply these as necessary until no trace of incandescence remains.
- (7) Ascertain the cause of the fire. If it is **ABSOLUTELY CERTAIN** that no further outbreak will occur due to the same cause and that no damage has been caused to any

vital equipment, the train may proceed after carrying out any relevant rules.

- (8) If the outbreak of fire is extensive return to the driving compartment immediately **CLOSING ALL BULKHEAD DOORS.**
- (9) Operate the fixed fire fighting equipment.
- (10) Ascertain as closely as possible the effectiveness of the fixed fire extinguishing equipment taking care to avoid personal **DANGER.**
- (11) If the fire appears to be beyond the capacity of the fire extinguishing equipment, obtain the assistance of the local Fire Brigade.

D.M.U. trains with automatic (Graviner) fixed fire extinguishing equipment will sound the alarm bells in the event of a fire occurring in the vicinity of a Diesel engine, fluid coupling or torque convertor.

If the fire bells ring:-

- (1) Note which engine has stopped by checking the indicator panel and bring the train to a stand.
- (2) Open the control circuit switch **IMMEDIATELY** the train has been brought to a stand.
- (3) Apply the handbrake.
- (4) Obtain a hand extinguisher and proceed to the affected car.
- (5) If the fire appears to be beyond the capacity of the extinguishers, call the local Fire Brigade. If the fire is of a limited nature assist the fixed equipment with the hand extinguishers until no trace of incandescence remains.
- (6) Isolate the affected engine on the fire control box and note that the red light is extinguished and the bells are silenced.
- (7) Turn the engine isolating switch to the **OFF** position.
- (8) Isolate the final drive associated with the defective engine. If the final drive cannot be isolated for any reason the train must not exceed 25 m.p.h. with gearbox transmission or 10 m.p.h. with torque converter transmission.
- (9) Thoroughly examine the equipment to ascertain if it is safe to proceed and if so, drive the train under reduced power (i.e. with engine(s) isolated) in accordance with instructions from the Traffic Control.

NOTES: A severe fire on a D.M.U. car may cause insulation damage to control wiring. This may result in equipment becoming inoperative and may also cause the control (No. 6) fuse to rupture before the train comes to a stand. It is therefore **VERY IMPORTANT** to open the control circuit switch immediately the train comes to a stand and leave it open until the jumper cables to the defective car are disconnected. See page 3 of B.R.33003/249.

If the automatic fire extinguishing equipment has operated, avoid breathing the gas or coming into contact with the liquid. The gas is heavier than air and

will therefore be more concentrated near the ground. First Aid treatment must be given to any person who comes into contact with a fire extinguishing liquid from the Graviner equipment.

Enginemmen should thoroughly acquaint themselves with the operation of all fire extinguishing equipment and request information if in doubt about its operation.

DERAILMENTS

Diesel locomotives and trains which have become derailed must only be re-railed by personnel from a breakdown gang or other authorised persons. Drivers must not attempt to move a derailed locomotive or multiple unit cars unless requested to do so by the person in charge of the re-railing operation.

ASSISTING DISABLED LOCOMOTIVES OR TRAINS

IMPORTANT : THE MAXIMUM SPEED WHEN ASSISTING MUST NOT EXCEED THAT OF THE UNIT WITH THE LOWEST MAXIMUM SPEED ON THE TRAIN.

Hauling a D.M.U. train

- (1) By another D.M.U. train with the same coupling code.
If the train has failed due to failure of the No. 6 fuse, proceed as in (2) below. Otherwise:-
 - (a) Stop the engines of the defective train.
 - (b) Couple the screw coupling, vacuum brake pipes, air pipes and jumper cables. Open the air pipe cocks.
 - (c) Isolate the engines.
 - (d) Isolate the final drives.
 - (e) Remove the reversing handle, control switch key and brake handle. Move the A.W.S. switch to the OFF position (B.R. type) or move the flags to the NOT IN USE position (W.R. type).
 - (f) Release the handbrake.
 - (g) Haul the train forward to the first point where it can be detached and taken out of service.

NOTE : The total weight of the train to be hauled must not exceed that of the assisting train.

- (2) By a locomotive or a D.M.U. train with a different coupling code.
 - (a) Stop the engines of the defective train.
 - (b) Couple the screw coupling, vacuum brake pipes and air pipes.
 - (c) Isolate the engines.
 - (d) Isolate the final drives (see note).
 - (e) Isolate all D.S.D. valves on the defective train.
 - (f) Remove the reversing handle, control switch key and brake handle. Move the A.W.S. switches to the OFF position (B.R. type) or move the flags to the NOT IN USE position (W.R. types).

- (g) Release the handbrakes.
- (h) Haul the train forward to the first point where it can be detached and taken out of service.

NOTE : The total weight of the train to be hauled must not exceed that of the assisting D.M.U. train.

If the final drives cannot be isolated a hauling speed of 25 m.p.h. must not be exceeded with gearbox cars and 10 m.p.h. must not be exceeded with torque convertor cars.

Hauling a Diesel locomotive with vacuum controlled air brakes

- (3) By a locomotive with vacuum/air brakes or auto air brakes.
 - (a) Ensure that no master keys are in position in either control desk and that the battery switch is open.
 - (b) Ensure that the A.W.S. switches are in the OFF position (B.R. type) or that the flags are in the NOT IN USE position (W.R. type).
 - (c) Isolate the driver's brake valves where possible, or place in the RUNNING position and place the straight air brake valves in the OFF position.
 - (d) Couple the screw couplings.
 - (e) Couple the vacuum brake pipes.
 - (f) Couple the main reservoir pipes and open the cocks.
 - (g) Observe that at least 85 p.s.i. air pressure registers on the main reservoir gauge of the dead locomotive.
 - (h) Ensure that all handbrakes are released.
 - (i) Work forward from the hauling locomotive with the brake selector switch in the VACUUM PASSENGER position.

Hauling a Diesel locomotive with automatic air brakes

- (4) By a locomotive fitted with automatic air brakes.
 - (a) Ensure that no master keys are in position in either driving desk and that the A.W.S. and battery switches are in the OFF position.
 - (b) Place the auto air brake valves in the SHUT DOWN or NEUTRAL position and place the straight air brake valves in the OFF position.
 - (c) Operate the air release valve.
 - (d) Couple the screw couplings.
 - (e) Couple the air brake pipes and open the cocks.
 - (f) Couple the main reservoir pipes and open the cocks.
 - (g) Observe that at least 85 p.s.i. air pressure registers on the main reservoir gauge and that 70 p.s.i. air pressure registers on the brake pipe gauge.
 - (h) Open the brake pipe cock at the rear of the defective locomotive. Observe that the brake pipe pressure drops to zero and that maximum brake cylinder pressure is registered. Close the rear cock.

- (i) Ensure that all handbrakes are released.
- (h) Work forward from the hauling locomotive with the brake selector switch in the **AIR PASSENGER** position.

Hauling a Diesel locomotive with automatic air brakes

- (5) By a locomotive fitted with vacuum air brakes.
 - (a) Ensure that no master keys are in position in either driving desk and that the A.W.S. and battery switches are in the OFF position.
 - (b) Davies and Metcalfe equipment only: Isolate the air vacuum relay valve, DV2.
 - (c) Isolate the Driver's Safety Device.
 - (d) Couple the screw couplings.
 - (e) Couple the main reservoir pipes and open the cocks.
 - (f) Couple the vacuum brake pipes.
 - (g) Observe that at least 85 p.s.i. registers on the main reservoir gauge and 21 ins. Hg is registered on the vacuum gauge.
 - (h) Test the brakes from the leading locomotive.
 - (i) Ensure that all handbrakes are released.
 - (j) Work forward from the hauling locomotive with the brake selector switch in the **VACUUM PASSENGER** position.

Hauling a defective locomotive with a train attached

- (6) If a dead locomotive and its train are to be hauled, the procedures described for hauling light locomotives must be carried out, but the brake tests must be performed at the rear of the train.

In the event of a locomotive fitted with vacuum/air brakes being required to assist a disabled locomotive fitted with auto air brakes and attached to an air braked train, it must be remembered that the **TRAIN BRAKES CANNOT BE APPLIED** from the leading locomotive and the remaining movement must be made as an "unbraked" train.

- (7) A locomotive with completely defective brakes, which is attached to a train, may be worked as a piped vehicle as follows:-
 - (a) Isolate the brake cylinders using the "Bogie isolating cocks."
 - (b) Couple the screw coupling.
 - (c) Couple the brake pipes according to the type of brake on the train, i.e. air or vacuum and open the cocks.
 - (d) Couple the main reservoir pipes if an air braked train is to be worked and open the cocks.
 - (e) Ensure that no master keys are in position and that the battery switch is open. Move the A.W.S. switches to the OFF position (B.R. type) or place the flags in the NOT IN USE position (W.R. type).
 - (f) Isolate the Driver's Safety Device.
 - (g) Ensure that all handbrakes are released.

(h) Test the brakes in the manner applicable to the type of train and proceed as necessary.

(8) Locomotives which cannot be used as piped vehicles

A dead locomotive with defective brakes and a defective brake pipe system, or a locomotive with defective brakes which is being hauled by a locomotive with an incompatible brake system, cannot be treated as a piped vehicle. If a train is attached it must be worked forward "unbraked" with its master key removed and the battery isolating switch open. The A.W.S. switches must be in the OFF position (B.R. type) or the flags must be in the NOT IN USE position (W.R. type). The Driver's Safety Device must be isolated.

Diesel shunting locomotives

Diesel shunting locomotives must be hauled "unbraked" at a maximum speed of 10 m.p.h. unless maintenance staff have de-meshed and given authority for a higher speed to be used. Under no circumstances should a speed of 25 m.p.h. be exceeded.

Electric locomotives and multiple units

Electric locomotives and multiple unit trains may be hauled 'dead' by a Diesel locomotive if they have been suitably prepared for such a movement and are mechanically safe to be moved. If the driver of the hauling locomotive is not trained in the operation of electric units, assistance must be obtained, before any movement is attempted, from a suitably trained person. If the driver of the hauling locomotive is trained in the operation of electric units, the following action must be taken before any attempt is made to perform any coupling operations.

- (a) Lower the pantograph(s).
- (b) Open the battery isolating switch(es).

Electric multiple unit trains

The automatic brakes of electric multiple unit trains, when being hauled 'dead' cannot be operated by locomotives unless of a type for which special arrangements have been made for multiple unit working. Unless special instructions have been issued to the contrary, electric multiple unit trains must be hauled as unbraked stock.

Electric locomotives

The automatic brake systems of electric locomotives are of the vacuum/air brake or automatic air brake types as found on Diesel locomotives. Electric locomotives can therefore be hauled 'light' or with a train attached if the same precautions are taken as for Diesel locomotives described in pages 10-12 incl.

An electric locomotive may be hauled attached to a train, with its pantograph raised, in order to provide train heating, if the driver of the electric locomotive authorises such a movement.

Assistance in the rear of trains

When assisting at the rear, the assisting locomotive must be coupled to the disabled train and the brake pipe must, if possible, be connected.

When the disabled train is vacuum braked, one of the locomotives must have its exhausters switched off. The exhausters on the leading locomotive should be used if they can be operated in the normal way.

The Passenger/Goods (brake selector) switch in the assisting locomotive must be in the same position as the one on the leading locomotive.

MULTIPLE WORKING

Diesel locomotives intended for multiple unit working are equipped with jumper cables and various air pipe connections. Coupling symbols are painted on the ends of the locomotives adjacent to the jumper cables and **ONLY** locomotives with identical coupling symbols can be worked in multiple.

The coupling symbols for locomotives are:-

<i>Coupling symbol</i>	<i>Type of locomotive</i>
Blue star	All Diesel electric locomotives with pneumatic control of the engine power.
White diamond	Diesel hydraulic locomotives Nos. D.6306-D.6357 and Nos. D.803-D.870. (Certain locomotives only).
Yellow triangle	Diesel hydraulic locomotives Nos. D.7000-D.7100.

The coupling symbols for Diesel multiple units are:-

<i>Coupling symbol</i>	<i>Type of D.M.U.</i>
Blue square: Power cars with driving compartments and mechanical transmission.	Nos. 50000-50935 50938-50987 51052-51153 51174-51590 51651-51680 51706-51730 51781-51967 51985-52105 55000-55035 55987-55996
Blue square: Power cars without driving compartments fitted with mechanical transmission.	Nos. 51968-51984
Blue square: Power cars with driving compartments and hydraulic (torque converter) transmission.	Nos. 51591-51650 51681-51705 51731-51779
Blue square: Driving trailer cars.	Nos. 56000-56169 56171-56173 56175-56215 56218-56289 56291-56319 56332-56504

Coupling symbol

Type of D.M.U.

Orange star:

Nos. 50988-51007

Power cars with driving compartments and hydraulic (torque converter) transmission.

51154-51173

White circle:

Nos. 50936

Power cars with a driving compartment and mechanical transmission.

51008-51051

79083-79111

79155-79168

Yellow diamond:

Nos. 55997-55999

Power cars with driving compartments and mechanical transmissions.

79008-79082

79118-79154

79169-79181

79184-79192

Yellow diamond:

Nos. 79250-79291

Driving trailer cars.

79600-79684

COUPLING OF LOCOMOTIVES FOR MULTIPLE WORKING

Diesel locomotives for multiple working should be coupled as follows:-

WITH NO MASTER KEYS FITTED IN ANY DRIVING POSITION:-

(1) Couple the screw coupling.

(2) Couple the vacuum pipes.

(a) When the locomotives are fitted with vacuum controlled air brakes.

(b) When the locomotives are fitted with automatic air brakes and are required to work a vacuum braked train.

(3) Couple the main reservoir pipes on one side of the locomotive only and open the cocks.

(4) Couple the automatic air brake pipes (automatic air braked locomotives only) and open the cocks.

(5) Couple the engine regulating air supply pipes on one side of the locomotive only and open the cocks.

(6) Couple the control jumper cable on one side of the locomotive only (both sides on Nos. D.803-D.870) and ensure that the safety catch springs into its locking position. Connect any safety chains fitted.

(7) Connect the heater pipes if necessary and open the cocks, but DO NOT connect the electrical heating jumpers between the locomotives unless it is required to heat the train from the leading locomotive.

STANDARD PREPARATION DUTIES FOR ALL TYPES OF MAIN LINE DIESEL LOCOMOTIVES COUPLED IN MULTIPLE

(1) IN DRIVING CAB

Enter the driving cab and deposit personal belongings and equipment.

(2) EXTERNAL EXAMINATION

Duties as for a single unit of the type of locomotive concerned to be carried out on both locomotives with the addition of

checking the intermediate couplings and that the intermediate pipe cocks are open.

(3) **IN THE DRIVING CAB**

Duties as for a single unit of the type of locomotive concerned.

(4) **INTERNAL EXAMINATION, LEADING UNIT, ENGINES STOPPED**

Duties as for a single unit of the type of locomotive concerned.

(5) ***INTERMEDIATE CAB OR CABS**

Duties as for a single unit of the type of locomotive concerned except that the engines are not to be started from intermediate cabs, the controls are in the OFF position, the master key is NOT in position and the A.W.S. is switched OFF.

(6) **INTERNAL EXAMINATION, TRAILING UNIT, ENGINES STOPPED**

Duties as for a single unit of the type of locomotive concerned.

(7) **REAR CAB OF TRAILING UNIT**

Duties as for a single unit of the type of locomotive concerned with the following additions:-

Start the engines and wait until the air pressure rises to 70 p.s.i. in the main reservoir on vacuum air braked locomotives and 85 p.s.i. on auto air braked locomotives.

Check the brakes and the Driver's safety device and isolate the exhausters when fitted with cab switches.

Remove the master key. Place the brake handles in the NEUTRAL or SHUT DOWN position on auto. air braked locomotives, or in the RUNNING or NEUTRAL position on vacuum/air braked locomotives.

Ensure that the power brakes are still applied.

Release the handbrake.

Ensure that the A.W.S. is switched OFF.

(8) **INTERNAL EXAMINATION, TRAILING UNIT, ENGINES RUNNING**

Return to the intermediate cab through the engine room and isolate the exhausters en route, when fitted with engine room exhauster switches.

(9) ***INTERMEDIATE CAB OR CABS**

Release the handbrakes.

(10) **INTERNAL EXAMINATION, LEADING UNIT, ENGINES RUNNING**

Duties as for a single unit of the type of locomotive concerned.

(11) **RETURN TO THE DRIVING CAB**

Check that the power brake is still applied.

Duties as for a single unit of the type of locomotive concerned.

*Not applicable to single cab locomotives.

STANDARD DISPOSAL DUTIES FOR ALL TYPES OF MAIN LINE DIESEL LOCOMOTIVES COUPLED IN MULTIPLE

(1) LEADING UNIT

Duties as for a single unit of the type of locomotive concerned.

(2) TRAILING UNIT

Duties as for a single unit of the type concerned except that the engines have already been stopped and there should be no control keys to remove.

UNCOUPLING OF LOCOMOTIVES AFTER MULTIPLE UNIT WORKING

- (1) In the driving compartment in use, place the reversing handle in the OFF position.
- (2) Place one vacuum or auto air brake valve, as applicable, in the EMERGENCY position in each locomotive.
- (3) Apply the handbrake in both locomotives.
- (4) (a) Close the brake pipe cocks, uncouple the pipes and replace the dummy couplers.
and/or
(b) Uncouple the vacuum pipes and place them on the dummy plugs.
- (5) Close the main reservoir pipe cocks, uncouple the pipes and replace the dummy couplers.
- (6) Close the regulating air pipe cocks, uncouple the pipes and replace the dummy couplers.
- (7) Close the heater pipe cocks, uncouple the pipes and secure them on the safety chains.
- (8) Disconnect the jumper couplings, insert them securely in the dummy sockets and attach the safety chains.
- (9) Uncouple the screw couplings.

OPERATION OF LOCOMOTIVES IN MULTIPLE

IMPORTANT: THE MAXIMUM SPEED OF COUPLED LOCOMOTIVES MUST NOT EXCEED THAT WHICH IS SPECIFIED FOR THE LOCOMOTIVE WITH THE LOWEST MAXIMUM SPEED.

- (1) The vacuum must be created (when necessary) on the leading locomotive only. The exhausters on the other coupled locomotive(s) must not be allowed to run unless defective on the leading locomotive.

No exhausters must be allowed to run on either locomotive if an air braked train is being worked.

- (2) The Goods/Passenger (brake selector) switch must be in the correct position, according to the type of train, on each locomotive.
- (3) The brakes must be applied by either the automatic air brake or vacuum brake valve, as appropriate, on ALL occasions other than for coupling purposes.
- (4) The A.W.S. apparatus must be in operation in the manned driving cab only.
- (5) Only the trip cock (if fitted) at the leading end of the leading locomotive must be used if working on London Transport lines.

NOTE : Drivers are reminded that the above instructions should be used along with the appropriate Driving Instructions for the types of locomotive to be worked.

COUPLING OF LOCOMOTIVES FOR TANDEM WORKING

Diesel locomotives with like or unlike controls, or a Diesel and an electric locomotive may be coupled together and worked in tandem.

Locomotives for tandem working should be coupled as follows:-

- (1) Couple the screw coupling.
- (2) Couple the vacuum pipes.
 - (a) When the locomotives are fitted with vacuum controlled air brakes.
 - (b) When the locomotives are fitted with automatic air brakes and are required to work a vacuum braked train.
- (3) Couple the main reservoir pipes on one side of the locomotive only, if an air braked train is to be worked or if one locomotive has a defective compressor when working a vacuum braked train. Open the cocks.
- (4) Couple the automatic air brake pipes (automatic air braked locomotives only) and open the cocks.
- (5) Couple the heater pipes if necessary, but **DO NOT** connect the electrical heating jumpers between the locomotives unless it is required to heat the train from the leading locomotive.
- (6) The standard preparation and disposal duties for locomotives to be worked in tandem should be carried out according to the instructions applicable to the individual locomotives.

OPERATION OF LOCOMOTIVES IN TANDEM

IMPORTANT : THE MAXIMUM SPEED OF COUPLED LOCOMOTIVES MUST NOT EXCEED THAT WHICH IS SPECIFIED FOR THE LOCOMOTIVE WITH THE LOWEST MAXIMUM SPEED.

- (1) The vacuum must be created (when necessary) on the leading locomotive only and the exhausters on the other coupled loco-

motive(s) must be isolated unless defective on the leading locomotive.

No exhausters must be allowed to run on either locomotive if an air braked train is being worked.

- (2) The Goods/Passenger (brake selector) switch must be in the correct position, according to the type of train, on each locomotive.
- (3) The brakes must be applied by either the automatic air brake or vacuum brake valve, as appropriate, on ALL occasions other than for coupling purposes.
- (4) The A.W.S. apparatus must be in operation in both driving cabs.
- (5) Only the trip cock (if fitted) at the leading end of the leading locomotive must be used if working on London Transport lines.

NOTE : Drivers are reminded that the above instructions should be used along with the appropriate Driving Instructions for the types of locomotive to be worked.

ATTACHING A LOCOMOTIVE TO A VACUUM BRAKED TRAIN

- (1) Place the Passenger/Goods switch (brake selector) in the **VACUUM PASSENGER** position or **VACUUM GOODS** position according to the type of train.
- (2) Drive the locomotive from the end to be coupled and stop when the locomotive and leading vehicle buffers are 6 ft. apart or when the locomotive buffers are opposite to a marker or hand-signalman.
- (3) When receiving a hand signal from the person performing the coupling operation, apply power in the first power (notch 1) position and make contact with the train. When the buffers are compressed, with power applied as necessary, apply the straight air brake and return the power controller to the **OFF** position immediately.
- (4) Destroy the vacuum by moving the driver's brake valve to the **EMERGENCY** position.
- (5) When the locomotive has been coupled to the train :-
 - (a) Move the reversing handle to the **OFF** position and remove the master key.
 - (b) Move the auto air brake handle to **NEUTRAL** or **SHUT DOWN** or the vacuum brake valve to **RUNNING**. Move the straight air brake valve to **OFF**.
(See the relevant Driving Instructions under "Changing ends").
 - (c) Switch off any route indicator lights etc. at the rear of the locomotive and return the blinds to the blank aspect.

- (d) Move the A.W.S. switch to the OFF position (B.R. system) or move the flag to the OUT OF USE position (W.R. system).
- (e) Proceed to the opposite end, ensuring that all rear cab doors are closed.

AT THE DRIVING END OF THE LOCOMOTIVE

- (f) Apply the handbrake.
- (g) Insert the master key and move the reversing handle to the E.O. position.
- (h) Close the A.W.S. switch (B.R. system) or move the flag to the IN USE position (W.R. system).
- (i) Release the vacuum brake.
- (j) Set the headcode.
- (k) Shut the engine down in accordance with the conditions specified on page 23 or as local instructions require.
- (l) Restart the engine in accordance with the conditions specified on page 23 or as local instructions require, apply the straight air brake and release the handbrake.
- (m) Operate the steam heating or electric heating apparatus as necessary and work the locomotive according to the relevant instructions. In the event of a locomotive and coaching stock both being fitted with steam and electric heating apparatus a clear understanding with the Guard must be obtained, regarding the system to be used. Electric heating must only be carried out when it is known that the coaching stock is compatible with the locomotive heating system.

ATTACHING A LOCOMOTIVE TO AN AIR BRAKED TRAIN

- (1) Place the Goods/Passenger switch (brake selector) in the AIR PASSENGER or AIR GOODS position according to the type of train and operate the vacuum release valve.
- (2) Drive the locomotive from the end to be coupled and stop when the locomotive and leading vehicle buffers are 6 ft. apart or when the locomotive buffers are opposite to a marker or hand-signalman.
- (3) When receiving a hand signal from the person performing the coupling operation, apply power in the first power (notch 1) position and make contact with the train. When the buffers are compressed, with power applied as necessary, apply the straight air brake and return the power controller to the OFF position immediately.

(4) When the locomotive has been coupled to the train:-

- (a) Move the reversing handle to the OFF position and remove the master key.
- (b) Move the straight air brake valve to the OFF position.
- (c) Move the automatic air brake valve handle to the FULL SERVICE position until the brakes are fully applied and then move it to the SHUT DOWN or NEUTRAL position. See the relevant Driving Instructions under "Changing ends."
- (d) Switch off any route indicator lights etc. at the rear end of the locomotive and return the blinds to the blank aspect.
- (e) Move the A.W.S. switch to the OFF position.
- (f) Proceed to the opposite end, ensuring that all rear cab doors are closed.

At the driving end of the locomotive

- (g) Apply the handbrake.
- (h) Insert the master key and move the reversing handle to the E.O. position.
- (i) Close the A.W.S. switch.
- (j) Release the brake and carry out the instructions contained in "REGULATIONS FOR WORKING THE AUTOMATIC AIR BRAKE ON LOCOMOTIVE OPERATED TRAINS CONTAINING VEHICLES EQUIPPED WITH DISTRIBUTORS AND OPERATING ON THE TWO PIPE SYSTEM" as given in Supplement No. 2 to the General Appendix dated March, 1968.
- (k) Set the headcode.
 - (l) Shut the engine down in accordance with the conditions specified on page 23 or as local instructions require.
 - (m) Restart the engine in accordance with the conditions specified on page 23 or as local instructions require, apply the straight air brake and release the handbrake.
 - (n) Operate the steam heating or electric heating apparatus as necessary and work the locomotive according to the relevant instructions. In the event of the locomotive and coaching stock both being fitted with steam and electric heating apparatus a clear understanding with the Guard must be obtained, regarding the system to be used.

COUPLING PROCEDURE, LOCOMOTIVE TO TRAIN

The Driver must ensure that locomotives are coupled in the correct manner. The procedure is as follows:-

With the buffers compressed

- (1) Using the locomotive coupling, couple the locomotive to the train.

(2) Vacuum braked trains:-

Connect the vacuum hose pipes.

Air braked trains:-

(a) Connect the main reservoir pipes and open the cocks.

(b) Connect the air brake pipes and open the cocks.

(3) All trains, as required:-

Couple the steam heating pipes and open the cocks

or

Couple the electric heating jumpers on BOTH sides.

(4) With the straight air brake valve applied move the air or vacuum brake valve to the RELEASE position and return it to the RUNNING position when the brakes are released.

UNCOUPLING OF A LOCOMOTIVE FROM A TRAIN OR FROM A TANDEM LOCOMOTIVE

(1) Ensure that the reversing handles are ALL in the OFF position.

(2) Place one vacuum or auto air brake valve, as applicable, in the EMERGENCY position in each locomotive.

(3) Apply the handbrake in both locomotives.

(4) (a) Close the brake pipe cocks, uncouple the pipes and replace the dummy couplers.

and/or

(b) Uncouple the vacuum pipes and place them on the dummy plugs.

(5) Close the main reservoir pipe cocks, uncouple the pipes and replace the dummy couplers. (Not applicable when uncoupling locomotives from vacuum braked trains).

(6) Close the heater pipe cocks, uncouple the pipes and secure them to the safety chains.

(7) Uncouple the screw couplings.

AMENDMENTS TO THE STANDARD PREPARATION AND DISPOSAL DUTIES FOR DIESEL LOCOMOTIVES AND DIESEL MULTIPLE UNIT TRAINS

With the exception of locomotives and Diesel multiple unit trains for which specific local exemptions have been made, add to all Standard Preparation and Disposal Duties the following:-

"Check that track circuit shorting bonds are available in each driving compartment."

Additionally, delete from all Standard Preparation and Disposal Duties for locomotives, all instructions concerning the collection of oil lamps and the use of these as tail lamps etc., unless local instructions are given to the contrary.

The above amendments will be made in all future issues of the Standard Preparation and Disposal Duties included in Part 2 of the instructions for all locomotives and multiple unit trains.

